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台達電子工業股份有限公司 DELTA ELECTRONICS, INC.		DESCRIPTION : 電氣規格(Electrical Specification)
THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF DELTA ELECTRONICS, INC. AND SHALL NOT BE REPRODUCED OR USED AS THE BASIS FOR THE MANUFACTURE OR SELL OF APPARATUSES OR DEVICES WITHOUT PERMISSION.		MODEL NO. : AC-171 G
Date: 02/07/'24	Drawn: 金雨霞	Design (EE): 羅東方 / Design (ME): 賈曉東
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1. SCOPE

This requirement defines the key characteristics for the power supply PDB specification. The specification that PS supplier provides shall include but not limited the characteristics in this requirement.

1.1 General

This is a multiple function power supply backplane assembly providing the following features:

- 12V to 3.3V DC to DC converter
- 12V to 5V DC to DC converter
- 12V to -12V DC to DC converter
- 12VSB to 5VSB DC to DC converter

1.2 Label:

The label shall be located at the location that it's easier to see when the system chassis is opened. The marking is legible and preserved permanently. The marking contents shall not be deteriorated due to heating or chemical influence. Model name and PS revision: REV:00, start from the first mass production

2. INPUT

2.1 INPUT Voltage/Current

DC input from 300W(DPS-300AB-102 X)、550W(DPS-550AB-36 X)、 650W(DPS-650AB-16 X)、800W(DPS-800AB-30 X) or 1200W(DPS-1200AB-16 X) output.
Each one module input as below table.

Module / Loading	12V (A)	12Vsb (A)
300W	24	1.5
550W	45	2.1
650W	52.5	2.1
800W	65	2
1200W	98	2.1

2.2 Efficiency

20%~100% rated load for cage's efficiency.

DC input from 300W(DPS-300AB-102 X):

Loading	Efficiency	5V	3.3V	12V	-12V	5Vsb

Light load (20%)	91%	1.92	1.37	3.57	0.07	0.43
Half load (50%)	93%	4.79	3.42	8.94	0.18	1.07
Max load (100%)	93%	9.58	6.84	17.88	0.36	2.14

DC input from 550W(DPS-550AB-36 X):

Loading	Efficiency	5V	3.3V	12V	-12V	5Vsb
Light load (20%)	91%	2.19	1.56	7.48	0.08	0.65
Half load (50%)	93%	5.47	3.91	18.68	0.2	1.63
Max load (100%)	93%	10.94	7.81	37.36	0.41	3.25

DC input from 650W(DPS-650AB-16 X):

Loading	Efficiency	5V	3.3V	12V	-12V	5Vsb
Light load (20%)	94%	2.25	1.61	8.59	0.08	0.67
Half load (50%)	95%	5.63	4.02	21.47	0.21	1.68
Max load (100%)	94%	11.26	8.04	42.95	0.42	3.35

DC input from 800W(DPS-800AB-30 X):

Loading	Efficiency	5V	3.3V	12V	-12V	5Vsb
Light load (20%)	94%	2.32	1.66	11.03	0.09	0.69
Half load (50%)	95%	5.81	4.15	27.58	0.22	1.73
Max load (100%)	94%	11.62	8.30	55.17	0.43	3.46

DC input from 1200W(DPS-1200AB-16 X in low voltage input):

Loading	Efficiency	5V	3.3V	12V	-12V	5Vsb
Light load (20%)	94%	2.36	1.69	13.3	0.09	0.70
Half load (50%)	95%	5.90	4.22	33.26	0.22	1.76
Max load (100%)	94%	11.81	8.43	66.53	0.44	3.51

DC input from 1200W(DPS-1200AB-16 X in high voltage input):

Loading	Efficiency	5V	3.3V	12V	-12V	5Vsb
Light load (20%)	94%	2.41	1.72	16.47	0.09	0.72
Half load (50%)	95%	6.03	4.31	41.17	0.22	1.79
Max load (100%)	94%	12.06	8.62	82.33	0.45	3.59

3. OUTPUT

3.1 Power/Currents Rating

The following tables define the power and current ratings. The combined output power of all outputs shall not exceed the rated output power. Load ranges are provided for each output level. The power supply shall meet both static, dynamic voltage regulation and timing requirements for the minimum/maximum/cross loading conditions.

Table 3.1 output power and current rating

signal	Minimum load(A)	Maximum load(A)	Power limit
+5V	0.5	14A peak1=18A peak2=22A	Continue load≤100W Peak load1≤120W (peak 300S every 900S) Peak load2≤150W (peak 60S every 900S)
+3.3V	0.5	10A Peak1=12A Peak2=18A	
+12V (With 300W Module)	0	23 peak 26A	
+12V (With 550W Module)	0	42 peak 45A	
+12V (With 650W Module)	0	48 peak 54A	
+12V (With 800W Module)	0	58 peak 63A	
+12V (With 1200W Module in low voltage input)	0	72 peak 77A	
+12V (With 1200W Module in high voltage input)	0	88 peak 93A	
-12V	0	0.5	
+5VSB	0.1	4	
Total continuous power		≤300W (With 300W Module) ≤550W (With 550W Module) ≤620W (With 650W Module) ≤770W (With 800W Module) ≤908W (With 1200W Module in low voltage input) ≤1100W (With 1200W Module in high voltage input)	

:

Footnotes:

1) The keep time of peak load shall be 12S for 12V every 10 minutes
2) The keep time of peak load1 shall be 300S for 5V&3.3V every 900S

3) The keep time of peak load2 shall be 60S for 5V&3.3V every 900S
4) Make sure the power supply will not be shut down and no component damage with peak load.

3.2 Voltage Regulation

The power supply output voltages must stay within the following voltage limits shown in *Table 3.2* when operating at steady state, dynamic loading conditions. And the overshoot at turn on conditions shall only meet the outputs voltage ±10% tolerance. All outputs are measured with reference to the return remote sense (ReturnS) signal. The 5V, 12V, –12V and 5VSB outputs are measured at the power supply connectors referenced to ReturnS. The +3.3V is measured at its remote sense signal (3.3VS) located at the signal connector if this connector is available. AC line Harmonic distortion of up to 10% THD shall not cause the power supply to go out of specified limits.

Table 3.2 voltage regulation limits

outputs	min	max	units	tolerance
+3.3V	+3.135	+3.465	Vdc	+ 5%-5%
+5V	+4.75	+5.25	Vdc	+ 5%-5%
+12V	+11.4	+12.6	Vdc	+ 5%-5%
-12V	-10.8	-13.2	Vdc	+ 10%-10%
+5VSB	+4.75	+5.25	Vdc	+ 5%-5%

3.2.1 Cross regulation load table

Table 3.2.1 Cross regulation load

DC input from 300W(DPS-300AB-102 X):

Item/Load	+5V/A	+12V/A	+3.3V/A	-12V/A	+5VSB/A	P t/ W	Remarks
1	0.5	0	0.5	0	0.1	4.7	Min Load
2	0.5	0	0.5	0	3	19.2	5VSB max, other min
3	0.5	23	0.5	0	0.1	280.7	12V max, other min
4	14	0	0.5	0	0.1	72.2	5V max, other min
5	14	14.91	9.1	0.5	3	300	5V & 3.3V combine 100W 5V max
6	0.5	0	10	0	0.1	36	3.3V max, other min
7	13.4	14.91	10	0.5	3	300	5V & 3.3V combine 100W 3.3V max
8	0.5	0	0.5	0.5	0.1	10.7	-12V max, other min
9	1.92	3.57	1.37	0.07	0.43	60	20% of Eff max load

10	4.79	8.94	3.42	0.18	1.07	150	50% of Eff max load
11	9.58	17.88	6.84	0.36	2.14	300	100% of Eff max load
12	Remote off				0.1	0.5	Remote off, 5VSB min
13	Remote off				3	15	Remote off, 5VSB max

DC input from 550W(DPS-550AB-36 X):

Item/Load	+5V/A	+12V/A	+3.3V/A	-12V/A	+5VSB/A	P t/ W	Remarks
1	0.5	0	0.5	0	0.1	4.7	Min Load
2	0.5	0	0.5	0	4	24.2	5VSB max, other min
3	0.5	42	0.5	0	0.1	508.7	12V max, other min
4	14	0	0.5	0	0.1	72.2	5V max, other min
5	14	35.33	9.1	0.5	4	550	5V & 3.3V combine 100W 5V max
6	0.5	0	10	0	0.1	36	3.3V max, other min
7	13.4	35.33	10	0.5	4	550	5V & 3.3V combine 100W 3.3V max
8	0.5	0	0.5	0.5	0.1	10.7	-12V max, other min
9	2.19	7.48	1.56	0.08	0.65	110.1	20% of Eff max load
10	5.47	18.68	3.91	0.2	1.63	275	50% of Eff max load
11	10.94	37.36	7.81	0.41	3.25	550	100% of Eff max load
12	Remote off				0.1	0.5	Remote off, 5VSB min
13	Remote off				4	20	Remote off, 5VSB max

DC input from 650W(DPS-650AB-16 X):

Item/Load	+5V/A	+12V/A	+3.3V/A	-12V/A	+5VSB/A	P t/ W	Remarks
1	0.5	0	0.5	0	0.1	4.7	Min Load
2	0.5	0	0.5	0	4	24.2	5VSB max, other min
3	0.5	48	0.5	0	0.1	580.7	12V max, other min
4	14	0	0.5	0	0.1	72.2	5V max, other min
5	14	41.16	9.1	0.5	4	620	5V & 3.3V combine 100W 5V max
6	0.5	0	10	0	0.1	36	3.3V max, other min
7	13.4	41.16	10	0.5	4	620	5V & 3.3V combine 100W 3.3V max
8	0.5	0	0.5	0.5	0.1	10.7	-12V max, other min

9	2.25	8.59	1.61	0.08	0.67	124	20% of Eff max load
10	5.63	21.47	4.02	0.21	1.68	310	50% of Eff max load
11	11.26	42.95	8.04	0.42	3.35	620	100% of Eff max load
12	Remote off				0.1	0.5	Remote off, 5VSB min
13	Remote off				4	20.0	Remote off, 5VSB max

DC input from 800W(DPS-800AB-30 X):

Item/Load	+5V/A	+12V/A	+3.3V/A	-12V/A	+5VSB/A	P t/ W	Remarks
1	0.5	0	0.5	0	0.1	4.7	Min Load
2	0.5	0	0.5	0	4	24.2	5VSB max, other min
3	0.5	58	0.5	0	0.1	700.7	12V max, other min
4	14	0	0.5	0	0.1	72.2	5V max, other min
5	14	53.66	9.1	0.5	4	770	5V & 3.3V combine 100W 5V max
6	0.5	0	10	0	0.1	36	3.3V max, other min
7	13.4	53.66	10	0.5	4	770	5V & 3.3V combine 100W 3.3V max
8	0.5	0	0.5	0.5	0.1	10.7	-12V max, other min
9	2.32	11.03	1.66	0.09	0.69	154	20% of eff max load
10	5.81	27.58	4.15	0.22	1.73	385	50% of eff max load
11	11.62	55.17	8.3	0.43	3.46	770	100% of eff max load
12	Remote off				0.1	0.5	Remote off, 5VSB min
13	Remote off				4	20.0	Remote off, 5VSB max

DC input from 1200W(DPS-1200AB-16 X in low AC voltage input):

Item/Load	+5V/A	+12V/A	+3.3V/A	-12V/A	+5VSB/A	P t/ W	Remarks
1	0.5	0	0.5	0	0.1	4.7	Min Load
2	0.5	0	0.5	0	4	24.2	5VSB max, other min
3	0.5	72	0.5	0	0.1	868.7	12V max, other min
4	14	0	0.5	0	0.1	72.2	5V max, other min
5	14	65.16	9.1	0.5	4	908	5V & 3.3V combine 100W 5V max
6	0.5	0	10	0	0.1	36	3.3V max, other min

7	13.4	65.16	10	0.5	4	908	5V & 3.3V combine 100W 3.3V max
8	0.5	0	0.5	0.5	0.1	10.7	-12V max, other min
9	2.36	13.3	1.69	0.09	0.7	181.6	20% of eff max load
10	5.9	33.26	4.22	0.22	1.76	454	50% of eff max load
11	11.81	66.53	8.43	0.44	3.51	908	100% of eff max load
12	Remote off				0.1	0.5	Remote off, 5VSB min
13	Remote off				4	20.0	Remote off, 5VSB max

DC input from 1200W(DPS-1200AB-16 X in High AC voltage input):

Item/Load	+5V/A	+12V/A	+3.3V/A	-12V/A	+5VSB/A	P t/ W	Remarks
1	0.5	0	0.5	0	0.1	4.7	Min Load
2	0.5	0	0.5	0	4	24.2	5VSB max, other min
3	0.5	88	0.5	0	0.1	1059.7	12V max, other min
4	14	0	0.5	0	0.1	72.2	5V max, other min
5	14	81.16	9.1	0.5	4	1100	5V & 3.3V combine 100W 5V max
6	0.5	0	10	0	0.1	36	3.3V max, other min
7	13.4	81.16	10	0.5	4	1100	5V & 3.3V combine 100W 3.3V max
8	0.5	0	0.5	0.5	0.1	10.7	-12V max, other min
9	2.41	16.47	1.72	0.09	0.72	220	20% of eff max load
10	6.03	41.17	4.31	0.22	1.79	550	50% of eff max load
11	12.06	82.33	8.62	0.45	3.59	1100	100% of eff max load
12	Remote off				0.1	0.5	Remote off, 5VSB min
13	Remote off				4	20.0	Remote off, 5VSB max

3.3 Ripple Noise

Table3.3 Ripple and Noise

VOLTAGE	Ripple/Noise pk-pk
+3.3V	50 mV
+5V	50 mV
+12V	120 mV
-12V	120 mV
+5VSB	50 mV

Footnotes:

1) This is measured over a bandwidth of 20Hz to 20MHz at the output connector. A 10μF tantalum capacitor in parallel with a 0.1μF ceramic capacitor are placed at the point of measurement.

*Adding a piece of low ESR electrolytic capacitance of 2200uF/16V in +12V output.

2) Ripple noise test must be at least in 5us/1ms/10ms sweep and peak detect mode.

3) When test 5Vsb、3.3V and 5V ripple noise, each output needs add a piece of 100uF/16V low ESR electrolytic capacitor.

3.4 Dynamic Loading

The load transient repetition rate shall be tested between 50Hz to 5 KHz at duty cycles range from10%-90%.The test shall be at least in 50 Hz/1KHz/5KHz condition. The load transient repetition rate is only a test specification.

The output voltages shall remain within limits specified in table 3.2 for the step loading, Slew rate, and capacitive loading in the table 3.4.

Table3.4 Transient Load Requirements

Output	Transient Step (A) XX % of rated current		A/us	Frequency (Hz)	Cap(uF)
	module	PDB or None redundant			
+5V		30%	0.5	50HZ - 5KHZ	1000
+12V		48%	0.5		2200
+3.3V		30%	0.5		1000
+5VSB		0.5A	0.5		20
-12V		0	0	0	10

Note: 1.For dynamic condition +12V Min loading is 1A.

2. While +12V dynamic Min load less than 2A, 12V shall follow +/-10% regulation.

3.5 Capacitive Loading

The power supply shall be stable and meet all requirements with the following capacitive loading ranges.

Table3.5 Output Capacitive loading

outputs	+5V	+3.3V	+12V	-12V	+5VSB
Cap load /uF	100-12000	100-12000	1000-22000	1--350	1--5000

3.6 No Load

The power supply turn on in no load condition shall not cause damage to the power supply. The power supply shall be able to turn up in no load condition.

3.7 Residual Voltage in Standby mode

Residual voltage at the power supply outputs for no load condition shall not exceed 100mV when AC voltage is applied and the PSON# signal is de-asserted

3.8 Redundant and hot swap

Hot swapping a power supply is the process of inserting and extracting a power supply module from an operating power system both stead and dynamic conditions with power cord as well as without power cord. In general, a failed (off by internal latch or external control) supply module may be removed, and replaced with a good power supply module. However, hot swap needs to work with operational as well as failed power supply module.
The power supply shall meet following requirements while hot remove or insert the module to the cage：

1. The output voltage shall stay within +/-8% regulation limit
2. DC signal, such as PG, PS-ON, present and other signals shall not oscillate or change,
3. Current Sharing bus shall not oscillate,
4. LED color shall not change,
5. Power supply shall not be overload and other protection,
6. The newly inserted power supply may get turned on by plugging AC into the external and meet the turn on requirements, including the voltage shown in table 3.2 and timing shown in table 4.1.
7. The two modules shall be synchronous while the power supply turn on, turn off, dropout and brownout. Any oscillation of voltage waveform due to the non-synchronous is not acceptable.

3.9 Remote Sense

Remote sense is necessary at 5V/3.3Voutputs and return sense. The remote sense should be able to regulate out voltage drop of 300mV minimum on voltage outputs as well as return. There are the values of resistor connecting between the remote sense and the out voltages internal to PDB.

3.10 Output Cable/Connector Requirement

REFER PD SPEC

4. TIMING & SEQUENCE

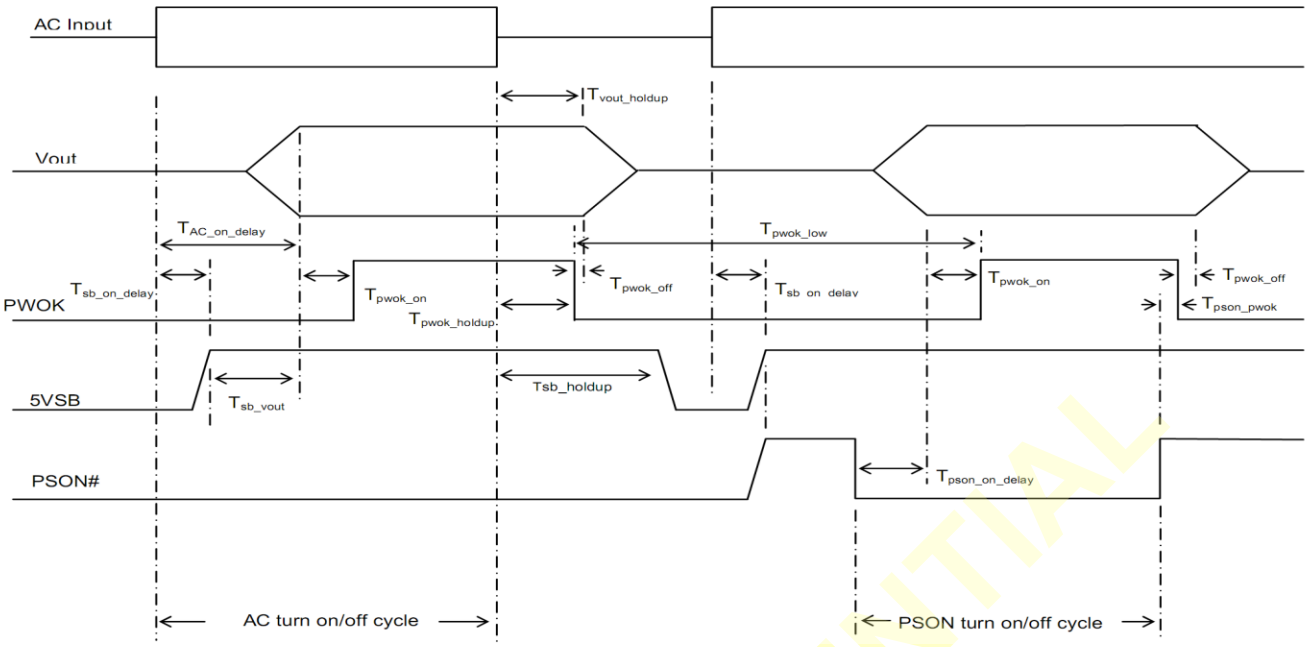
4.1 General Timing

These are the timing requirements for power supply operation including alone module outputs and multi model outputs. All outputs shall rise monotonically. The 3.3V output shall not exceed the 5V output by more than 0.5V at power on.
In general, 5V/3.3V rise waveform shall soft-start from the time when 12V goes to regulation limit if 5V/3.3V is converted from 12V, and 5VSB rise waveform shall soft-start from the time when 12VSB goes to regulation limit if the 5VSB is converted by 12VSB.
However, PS timing must meet the requirement of mother board.
The criteria in below table is recommended.

Table 4.1 Turn On/Turn Off Timing

ITEM	DESCRIPTION	MIN	MAX	UNIS
T_{vout_rise}	Output voltage rise time for main outputs and 5VSB from 10% to within regulation limits.	1	50	msec
T_{vout_on}	All main outputs must be within regulation of each other within this time.		50	msec
$T_{sb\_on\_delay}$	Delay from AC being applied to 5VSB being within regulation.	0	1500	msec
$T_{ac\_on\_delay}$	Delay from AC being applied to all output voltages being within regulation.		2500	msec
T_{vout_holdup}	Time all output voltages stay within regulation after loss of AC. (At 70% Full load). T5vsb hold up time.	12 25		msec
T_{pwok_holdup}	Delay from loss of AC to deassertion of PWOK	11		msec
$T_{pson\_on\_delay}$	Delay from PSON# active to output voltages within regulation limits.	5	400	msec
T_{pson_pwok}	Delay from PSON# deactive to PWOK being deasserted.		50	msec
T_{pwok_on}	Delay from output voltages (3.3V, 5V, 12V, -12V) within regulation limits to PWOK asserted at turn on.	200	500	msec
T_{pwok_off}	Delay from PWOK deasserted to output voltages (3.3V, 5V, -12V) dropping out of regulation limits.	1		msec
T_{pwok_low}	Duration of PWOK being in the deasserted state during an off/on cycle using AC or the PSON signal.	100		msec
T_{sb_vout}	Delay from 5VSB being in regulation to O/Ps being in regulation at AC turn on.	10	1500	msec

Figure 1 Timing diagram



4.2 Control Signal and Other DC Signals

4.2.1 PG Signal (PWOK)

The power supply shall provide a TTL compatible PWOK signal to the system. The combined PWOK signal from two power supply modules shall use logic “OR”; And the ultimate PWOK signal to the motherboard from the combined PWOK and DC-DC converter shall use logic “AND”.

Table 4.2.1 PWOK TTL Characteristics

Signal type	TTL compatible
Logical low voltage	∠0.4V, 4mAsink current
Logical high voltage	4.4VDC - 5.25VDC
Sink current, PWOK= low	≤4mA
PWOK rise and fall time	≤ 100us
High-state output impedance	A pull up resistor is between PWOK output and 5VSB voltage located in power supply

4.2.2 PS-ON Signal

PSON# signal is required to remotely turn on/off the power supply. PSON# is the active low signal that turns on the +12V power rail and other DC to DC converters. When this signal is not pulled low by the system, or left open, all the outputs (except for 5VSB) shall be turned off. This signal is pulled to a 3.3VSB voltage by a pull-up resistor internal to the power supply. Refer to Figure 1 On/Off Timing for timing diagram.

Table 4.2.2 PS_ON Characteristics

Logical low voltage (Vil)	0.0—1.0V
Logical high voltage(Vih；Iin=-200Ua)	≥2V
Source current(Iil ,Vin=0.4V)	≤4mA
Open status(Iin=0)	≤ 5.25V
Power-on status	PS_ON= 0
Power-off status	PS_ON= 1 or open state

4.2.3 PSU PMBus Setting Time

PSU PMBus needs 500ms to do internal initial setting, in this setting period we don't allowed any access actions through PMBus. System communicates with PSU after PSON 500ms.

4.2.4 SMBAlert Signal

This signal indicates that the power supply is experiencing a problem that the user should investigate. This shall be asserted due to Critical events or Warning events. The signal shall activate in the case of critical component temperature reached a warning threshold, general failure, over-current, over-voltage, under-voltage, failed fan. This signal may also indicate the power supply is reaching its end of life or is operating in an environment exceeding the specified limits. This signal is to be asserted in parallel with LED turning solid Amber or blink Amber.

TABLE 1 SMBALERT# SIGNAL CHARACTERISTICS

Signal Type (Active Low)	Open collector / drain output from power supply. Pull-up to VSB located in system.(System provide the pull-up voltage (3.3V or 5V))	
ALERT# = HIGH	OK	
ALERT# = LOW	Power Alert to system	
	MIN	MAX
Logic level low	0V	0.4V
Logic level high	2.4V	5.25V

System provide the pull-up voltage (3.3V or 5V)

PSU1 Module	PSU2 Module	Cage work	SMBAlert	Buzzer mute
Installed	Installed	OK	High	N/A

Installed	Failure	OK	Low	Alarm
Failure	Installed	OK	Low	Alarm
Installed	Not Installed	OK	High	N/A
Not Installed	Install	OK	High	N/A
Not Installed	Failure	Fail	Low	Alarm
Failure	Not Installed	Fail	Low	Alarm
Installed	Installed	Fail	Low	Alarm
Installed	Not Installed	Fail	Low	Alarm
Installed	Failure	Fail	Low	Alarm
Failure	Installed	Fail	Low	Alarm
Not Installed	Installed	Fail	Low	Alarm

Note:
Installed=Module is installed in the drawer and working well
Not Installed=No module, drawer is empty
Failure=Defective module installed in the drawer（except -12V.5VSB）（OCP, AC Loss, OTP， OVP, Fan locked）
The buzzer alarm can be reset in any of the following ways.
1). System sends PMbus command B0H;

Alert Warning Trip Levels (Alert# = Low)

	Min.	Typ.	Max.
3.3V Over Current Warning	20A	21.5 A	23A
5V Over Current Warning	29A	30.5A	32A
12V Over Current Warning	97A	104A	114.5A
Over temperature warning(OTW)	--	63℃	--
Module Alert Warning	Any Module Alert is Low		

4.2.5 Buzzer

status		LED	buzzer
1 module +1PDB	AC or DC input voltage turn off, power supply internal energy complete release	off	--
	AC or DC input voltage normal ,standby mode	green blinking(1Hz)	--
	AC or DC input voltage normal , module or PDB fault(PS_ON)	Amber continuously(module fault) green blinking(PDB fault)	alarm

2 module +1 PDB	AC or DC input voltage normal ,two modules shall be synchronous work(PS_ON),remove one module input voltage	Amber continuously (module of no input voltage) green continuously(module of input voltage)	alarm
	AC or DC input voltage normal(PS_ON) , module fault	Amber continuously	alarm
	two modules shall be synchronous, only one module input voltage(AC or DC) turn on(PS_ON)(first input voltage)	Amber continuously (module of no input voltage) green continuously(module of input voltage)	alarm
	module normal working	green continuously	--

4.2.6 SCL and SDA

Both signal line will be used as communication interface for PMBus. Open pin is the serial clock(SCL),
and the other is used for serial data(SDA). The SCL and SDA signals are pulled up by PDB, both pins are bi-directional, open drain signals and are used to form a serial bus.

5. PROTECTION

5.1 Power Supply Turn On After Protection

Power supply shall shut down and latch-off by fault or protection. Protection circuits inside the power supply shall only cause the power supply's main outputs to shut down. When this fault or protection is removed, Power supply must be able to turn up through toggling PS ON/OFF or AC ON/OFF re-cycle. The toggling time is <=1S by PSON turn on mode, and <=15S by AC on mode. The 5VSB protection mode is auto restart once the fault or protection is removed.

5.2 OVP

Table 5.2 Over voltage protection

Voltage	Min	Max	Unit
+3.3V	+3.7	+4.3	VDC
+5V	+5.7	+6.5	VDC
+12V	+13	+15	VDC
-12V	-13.5	-15	VDC
5VSB	+5.7	+6.5	VDC

Footnotes:
1) OVP state on Main outputs shall shutdown and latch off. When 5Vsb OVP condition is remove, 5Vsb and main outputs shall be Auto Restart itself.

5.3 OCP

Table5.3 Over current protection

Voltage	Module	Power supply PDB		
		Min	Max	Unit
+3.3V		20	26	A
+5V		29	35	A
-12V		0.6	2	A
5VSB		6	10	A

Footnotes:

1) OCP state on Main outputs shall shut down and latch off, and shall be cleared by toggling the PSON# signal or by an AC input re-cycle，5VSB OCP shall be Auto Restart when OCP condition is removed.
2) 12V OCP depend on Modules, as table5.3.1

Table5.3.1 Over current protection

Voltage	Module	Power supply PDB		
		Min	Max	Unit
12V	DPS-300AB-102 X	29	40	A
	DPS-550AB-36 X	52	60	A
	DPS-650AB-16 X	63	73	A
	DPS-800AB-30 X	77	84	A
	DPS-1200AB-16 X with low line	90.2	123	A
	DPS-1200AB-16 X with high line	107.8	147	A

5.4 Short Circuit Protection

The power supply shall shut down and latch off when any output is short circuit(impedance less than 0.1ohm) with any other outputs, whatever the outputs is shorten when power supply is running as well as before turn on.

1) The power supply shall be no physical damage when +12V,+5V,+3.3V,-12V,5VSB output is shorted to its DC return.
2) 5VSB shall be Auto Restart when short condition is removed.

5.5 No load Condition

No protection occurs when power supply operates in no load condition.

5.6 Over Temperature Protection

The power supply shall be protected against over temperature conditions caused by loss of fan cooling or excessive ambient temperature, which could cause internal parts failures. In an over temperature condition the PS shall shutdown. The Standby output shall not shutdown during an OP condition on the main outputs. When the temperature drops to within safe operating limit for internal parts, the power supply shall restore power automatically. The OTP circuit shall incorporate built in hysteretic (>5°C) such that the power supply does not oscillate on and off due to temperature recovering condition. The OTP trip level shall have a minimum of 5℃ of ambient temperature margin.

Tabel 5.6 **Inlet Ambient Sensor Trip Level**（**reference**）

	TYPE
Over temperature warning(OTW)	63℃
Over temperature Protection(OTP)	68℃

5.7 Immunity voltage from system at outputs rail

The Power supply shall be immune to any residual voltage placed on its outputs (Typically a leakage voltage through the system from standby output) up to 500mV. There shall be no additional heat generated, stress of any internal components, nor protection circuit trip during turn on with this voltage applied to any individual output, and all outputs simultaneously.

6. ENVIRONMENT REQUIREMENT

6.1 Temperature

6.1.1 Operating Temperature

+0°C Min，+55°C Max
(Full load and all input voltage range, temperature change rate 5°C/min~10°C/h is accepted)
This temperature is the input temperature at the wind inlet of the cage.

6.1.2 None operating temperature(storage)

-40°C Min, +80°C Max

6.2ROHS

Power supply must be Rohs compliant including the component, PCB, soldering material, case, wire, process.

6.3Humidity

operating (non-condensing): 5% to 90%
Make sure to thoroughly test the higher values (50 degrees and 95% humidity)
Non-operating (non-condensing): 5% to 95%

6.4 Altitude:5000m

7. Power supply monitor and control

PM bus specification 1.2 shall be used for the communication with system.
The power supply shall comply with Intel Node manager2.0 specification.

8. Load sharing and compatibility

8.1 Load sharing

The backplane combined power, the current sharing accuracy should be within (+10%, -10%) at 20% to 100% load. The accuracy shall be calculated by：（M1-M2）/M1，or（M1-M2）/M2. For example M1=10W(input power)，M2=9.1-11W(input power).

8.2 Compatibility

This PDB could compatible with different PSU，defined as 300W(DPS-300AB-102 X)、550W(DPS-550AB-36 X)、650W(DPS-650AB-16 X)、800W(DPS-800AB-30 X) or 1200W(DPS-1200AB-16 X). But could not mixture match with different PSU (such as 650W mixture match with 800W ，or 300W mixture match with 1200W and so on).

9. Reliability

9.1 E-cap life

100% of full load、 50℃ not less than 3years;

9.2 MTBF

The power supply should have a minimum MTBF at continuous operation of 100,000 hours at 100% load and 50 ℃.

9.3 Shock

Non-operating, half sine, 50G, 11ms, 3 times on each of 6 faces

9.4 Vibration

Non-operating
0.015g2/Hz 3 to 100 Hz
-6dB/octave 100-137Hz
0.008g2/Hz 137 to 350 Hz

-6dB/octave 350-500Hz
0.0039g2/Hz 500 Hz
2.09Grms
20 minutes / axis, all three axes

10. PMBus

The PS+PDB combo shall provide a monitoring interface to the system over a system management bus to the system. Device should be compatible with both PMBus 1.2 spec and I2C Vdd based power and drive. This bus shall operate at 3.3V. The SMBus pull-ups are located on the PDB.
This shall provide power monitoring, failure conditions, warning conditions. Two pins have been reserved on the connector to provide this information. One pin is the Serial Clock (SCL). The second pin is used for Serial Data (SDA). Both pins are bi-directional and are used to form a serial bus.

10.1 Addressing

For redundant power systems there may be a power distribution board (PDB). In this case there may need to be a PMBusTM device on the PDB. If the PDB is passive then the PMBusTM device on the PDB may not be needed. Below are the PDB device address locations: PDB PMBusTM address: 4Ah

10.2 Data Formats

The data format for current, voltage, power, temperature, and fan speed shall use the PMBus Literal format.
Literal data format: X = Y · 2N
X = the sensor value in volts, amps, watts, degrees C, or RPM
Y = mantissa
The mantissa is the variable components that changes as the sensor value changes. Y is a 16 bit unsigned value for the READ_VOUT command. For all other READ commands Y is a 11 bit signed 2's compliment value.
N = exponent. The exponents are fixed for each power supply and define the resolution for each sensor.

10.3 Accuracy

The sensor commands shall meet the following accuracy requirements.

	Required Accuracy (+/-x% of equipment reading) (Vin range=(100v~127v) or (200v~240v))		
Output Loading	<10%	10% - 20%	>20%
READ_POUT	No spec	+/-10%	+/-5%
READ_IOUT	No spec	+/-10%	
READ_VOUT	+/- 5% over full range		

10.4 VOUT_MODE

For reading output voltages the power supply shall support the VOUT_MODE command to report the output voltage formatting for the READ_VOUT command. The VOUT_MODE shall be set to Linear and the exponent (N) shall be set to -9.

Table 11: VOUT_MODE settings for reading output voltage(s).

Mode	Bit[7:5]	Bit[4:0]
Linear	000b	10111b(-9)

10.5 Sensor Formatting Tables

These tables define the values for N and associate resolutions that are supported for each range of power supply parameters. The value of N shall be fixed for a given power supply and sensor based on the power supplies capabilities.

READ_IOUT	N	Peak(Amps)	Resolution(Amps)
	-7	0 to < 8	0.007813
	-6	8 to <16	0.015625
	-5	16 to < 32	0.03125
	-4	32 to < 64	0.0625
	-3	64 to <128	0.125
	-2	128 to <256	0.25

READ_POUT	N	Peak(Watts)	Resolution(Watts)
	-3	0 < 128	0.125
	-2	128 to < 256	0.25
	-1	256 to < 512	0.5
	0	512 to <1024	1
	1	1024 to < 2048	2
	2	2048 to < 4096	4

10.6 Monitoring Power/current/voltage

The following PMBus commands shall be supported for the purpose of monitoring currents, voltages, and power.

PMBus command	Description
READ_IOUT	Output current of the selected output in amps
READ_VOUT	Output voltage of the selected output in volts
READ_POUT	Total output power of the monitored outputs in watts

For power supplies or power distribution boards with multiple outputs the PAGE command shall be supported. The following PAGEs shall be assigned to support standard voltages.

Item	Output	Page

		location
1	12V	00h
2	5V	01h
3	3.3V	02h

10.7 Status Commands

The following PMBus status commands shall be supported.

CLEAR_FAULTS
STATUS_WORD

Low Byte

Bit	Bit Name Meaning
7	not used
6	OFF power supply is off for any reason
5	VOUT_OV_FAULT any output overvoltage fault has occured
4	IOUT_OC_FAULT any output shuts down due to over current
3	not used
2	TEMPERATURE temperature shut down or warning condition
1	CML A communication, memory or logic fault has occured
0	NONE OF ABOVE the fault or warning not listed in bits [7:1]

High Byte

7	VOUT An output voltage fault or warning has occurred
6	IOUT Output current fault or warning event
5	INPUT Input current or voltage fault or warning event
4	not used
3	POWER_GOOD# Power good is de-asserted
2	not used
1	not used
0	UNKNOWN Other FAILURE Power supply is shut down for other reasons and not listed in bits [15:1]

STATUS_IOUT

Bit	Meaning
7	not used
6	not used
5	IOUT_OC_WARNING over current warning
4	not used
3	not used
2	not used
1	not used
0	POUT_OP_WARNING Out over power warning

STATUS_INPUT

Bit	Meaning
7	not used
6	not used
5	not used
4	not used
3	Unit is OFF due to insufficient input voltage
2	not used
1	not used
0	not used

STATUS_TEMPERATURE

Bit	Meaning
7	OTP_FAULT Over temperature fault
6	not used
5	not used
4	not used
3	not used
2	not used
1	not used
0	not used

STATUS_CML

Bit	Meaning
7	Invalid or unsupported command received
6	Invalid or unsupported data received
5	Packet error check failed
4	not used
3	not used
2	not used
1	not used
0	not used

10.8 Limit commands

The following PMBus commands shall be supported to allow the system to set warning limits. If one of the warning limits are exceeded the appropriate bit in the status register shall be set.

Command	Meaning
VOUT_OV_FAULT_LIMIT	Output over voltage fault limit
IOUT_OC_FAULT_LIMIT	Output over current fault limit
IOUT_OC_WARN_LIMIT	Output over current warning limit
POUT_OP_WARN_LIMIT	Output over power warning limit

Default Limits for System Controllable Limits

The default values for system controllable limits shall be set to the power supplies maximum capabilities.

10.9 Faults and Error Correction

The power supply shall support PEC protocols as well as the STATUS_CML command to support error checking and handling.

10.10 Capability and inventory reporting

The follow commands shall be supported for discovery of the power supplies capabilities.

Command	Meaning
CAPABILITY	Defines the power supplies PEC support, bus speed, and support of SMBAlert
QUERY	Used to determine if the power supply supports a specific command
PAGE	Used to QUERY a specific output of a multi output power supply
Revision and inventory information	
SHUTDOWN_BUZZER	
CUSTOMER_CMD	Used to turn on one or two modules
FW_VER_DATE	
PMBUS_REVISION	
MFR_ID	
MFR_MODEL	
MFR_REVISION	
MFR_VOUT_MIN	
MFR_VOUT_MAX	
MFR_IOUT_MAX	
MFR_POUT_MAX	
MFR_TAMBIENT_MAX	
MFR_EEPROM_W	
MFR_EEPROM_R	

10.11 Write Protection

The WRITE_PROTECT command shall be supported. There is one added call to the WRITE_PROTECT command.

Data Byte	Value Meaning
0001 0000	Disables all commands but the WRITE_PROTECT, PAGE, and all MFR_xxxx

10.12 PMBus Commands Set

Following below table shows mandatory PMBus commands to be supported by the PSU.

Command Code	Command Name	Number Of Data Bytes	PSU Transaction Type
00h	PAGE	1	R/W Byte
03h	CLEAR_FAULTS	0	Send Byte

10h	WRITE_PROTECT	1	R/W Byte
19h	CAPABILITY	1	Read Byte
1Ah	QUERY	1	Block Write/Read Process Call
20h	VOUT_MODE	1	Read Byte
40h	VOUT_OV_FAULT_LIMIT	2	Read Word
44h	VOUT_UV_FAULT_LIMIT	2	Read Word
46h	IOUT_OC_FAULT_LIMIT	2	Read Word
4Ah	IOUT_OC_WARN_LIMIT	2	R/W Word
6Ah	POUT_OP_WARN_LIMIT	2	R/W Word
70h	FW_VER_DATE		Read Block
79h	STATUS_WORD	2	Read Word
bit6	OFF		
bit5	VOUT_OV_FAULT		
bit4	IOUT_OC		
bit2	TEMPERATURE		
bit1	CML		
bit0	NON OF THE ABOVE		
(High)bit7	VOUT		
bit6	IOUT/POUT		
bit5	INPUT		
bit3	POWER_GOOD#		
bit0	UNKNOWN		
7Bh	STATUS_IOUT	1	Read Byte
bit5	IOUT_OC_WARNING		
bit0	POUT_OP_WARNING		
7Ch	STATUS_INPUT	1	Read Byte
bit3	INSUFFICIENT_INPUT		
7Dh	STATUS_TEMPERATURE	1	R/W Byte
bit7	TEMPERATURE_FAULT		
7Eh	STATUS_CML	1	Read Byte
bit7	COMMAND_FAULT		
bit6	DATA_FAULT		
bit5	PEC_FAULT		
8Bh	READ_VOUT	2	Read Word
8Ch	READ_IOUT	2	Read Word
96h	READ_POUT	2	Read Word
98h	PMBUS_REVISION	1	Read Byte
99h	MFR_ID	Variable	Block Write/Read
9Ah	MFR_MODE	Variable	Block Write/Read
9Bh	MFR_REVISION	Variable	Block Write/Read
A4h	MFR_VOUT_MIN	2	Read Word

A5h	MFR_VOUT_MAX	2	Read Word
A6h	MFR_IOUT_MAX	2	Read Word
A7h	MFR_POUT_MAX	2	Read Word
A8h	MFR_TAMBIENT_MAX	2	Read Word
F0h	LENOVO_CMD	2	Write Word
FCh	MFR_EEPROM_W	Variable	Block Write/Read
FDh	MFR_EEPROM_R	Variable	Block Write/Read